Lessons Learned using the JNTF Verification & Validation Process

Mr. Ronald Pipes, TRW
Joint National Test Facility
Schreiver AFB, Colorado Springs

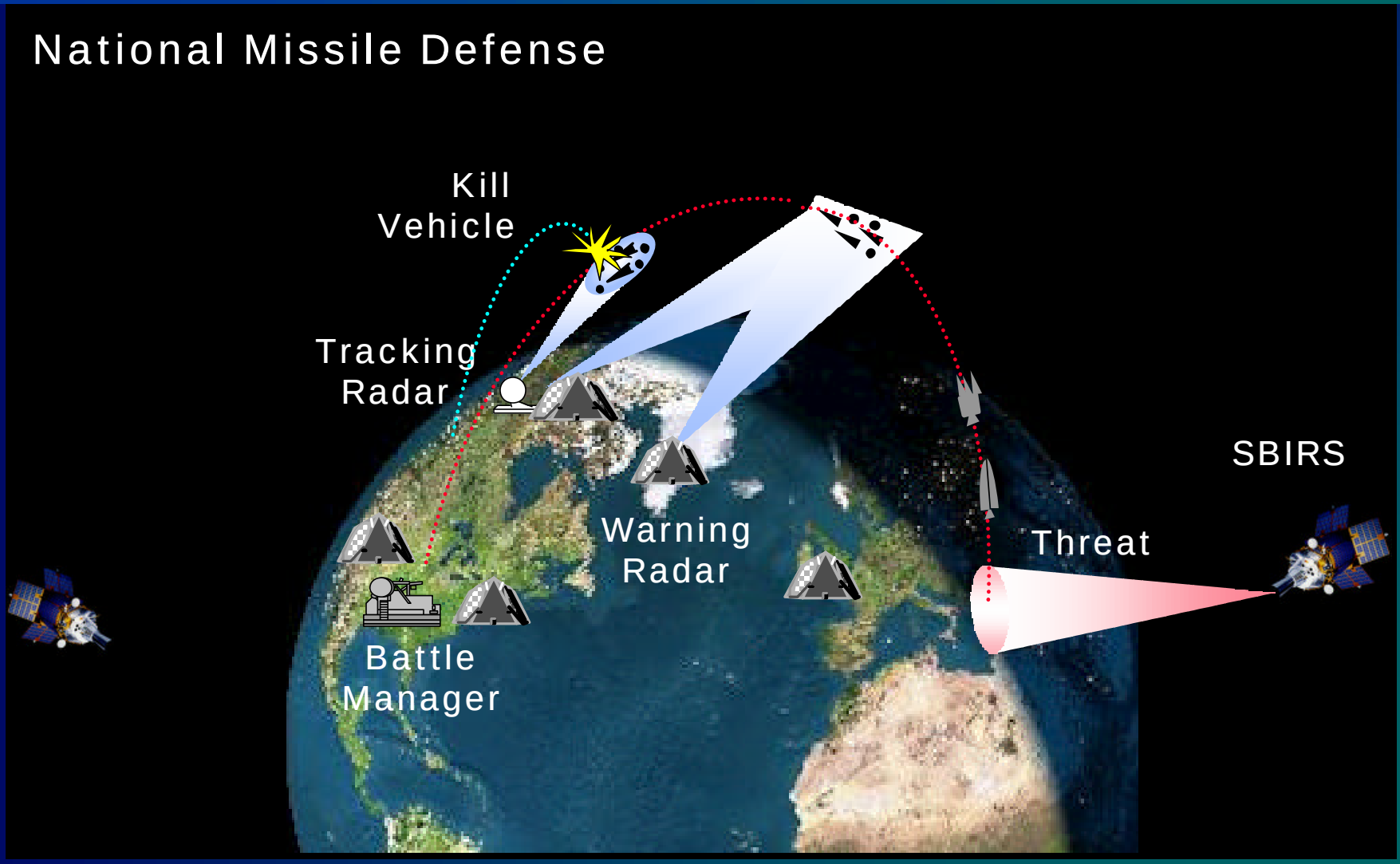
Overview

- The National Missile Defense (NMD) High Fidelity System Simulation (HFSS)
- JNTF V&V Methodology Overview
- Tailoring
- Lessons Learned
- Summary

HFSS Overview

- HFSS is an end-to-end NMD simulation (Threat Launch to Negation or Impact)
- HFSS intended use
  - Systems engineering studies
  - System performance verification
- Developed by the NMD Systems Engineering Contractor
- Verification and Validation performed by the JNTF and the Naval Surface Warfare Center

Overview


National Missile Defense
Kill Vehicle
Tracking Radar
Warning Radar
Battle Manager
SBIRS
Threat

V&V Constraints

Limited Documentation

Distributed Team

Preliminary Release

Evolving System

Early Assessment Required

JNTF V&V Methodology
39 Procedures Available

Conceptual Validation	Software Verification	Operational Validation	Data Validation
• Development history analysis	• CASE and design methodology adherence analysis	• Animation test	• Input data analysis
• Model derivative analysis	• Screening procedure	• Fixed value test	• Data consistency analysis
• Previous model use analysis	• Process metrics analysis	• Simplified assumption testing	• Portrayal of constants analysis
• Requirements criticality analysis	• Products metric analysis	• Extreme condition testing	• Distribution form analysis
• System analysis	• Internal software testing analysis	• Predictive validation testing	
• Modeling concepts analysis	• Code analysis	• Output validation analysis	
• Input/output fidelity analysis	• Security code analysis	• Comparison to test data	
• Algorithm analysis	• QA review	• Sensitivity analysis	
• Logic trace analysis	• Documentation review	• Feedback loop analysis	
	• User support review	• Event sequencing testing	
	• Model flexibility assessment	• Head to head comparison	
	• CM Review	• Input/output relationship analysis	
	• IV&V Review		
	• Graphical display evaluation		

JNTF V&V Methodology
4 Procedures Selected

Conceptual Validation

- Development history analysis
- Model derivative analysis
- Previous model use analysis
- Requirements criticality analysis
- [illegible] analysis
- Algorithm analysis
- Logic trace analysis

Modeling Concept Analysis

Software Verification

- CASE and design methodology adherence analysis
- Screening procedure
- Process metrics analysis
- Products metric analysis
- Internal software testing analysis
- Code analysis
- Security code analysis
- QA review
- Documentation review
- User support review
- Model flexibility assessment
- CM Review
- IV&V Review
- Graphical display evaluation

Operational Validation

- Animation test
- Fixed value test
- Simplified assumption testing
- [illegible]
- Predictive validation testing
- Output validation analysis
- [illegible] data
- Feedback loop analysis
- Event sequencing testing
- Head to head comparison
- Input/output relationship analysis

Extreme Condition Test

Sensitivity Analysis

Data Validation

- [illegible] analysis
- Portrayal of constants analysis
- Distribution form analysis

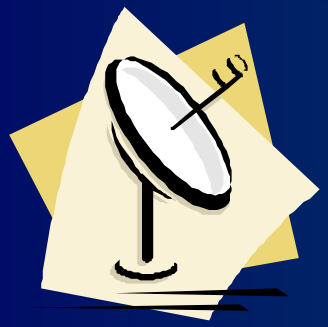
Input Data Analysis

JNTF V&V Procedures

Specific Procedures:

Model Concepts Analysis	Input Data Analysis
Threat SBIRS Interceptor UEWR XBR BMC3 IFICS Environment	Threat Scenario 1
Extreme Condition	**Sensitivity Analysis**
Ideal Performance Degraded Performance	Interceptor SBIRS Battle Manager Radar

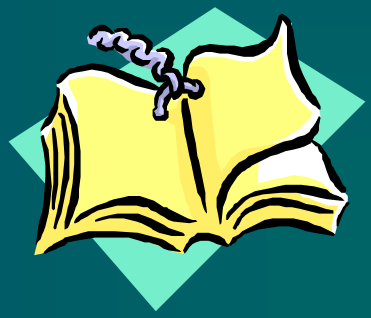
Lessons Learned



Communications. VTCs and Telecons. E-Mail Relay. Regular Visits and team coordination meetings. On-site presence at the development site

Computer Resources. Start early on acquisition and configuration of H/W and S/W (especially COTS).

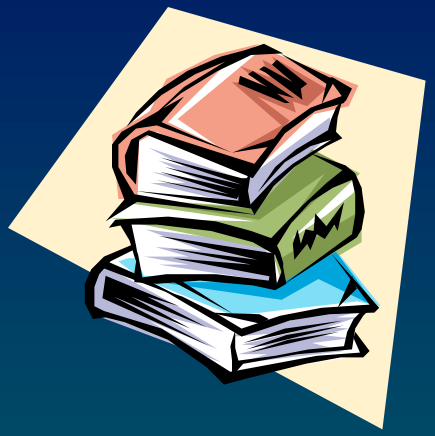
V&V Readiness Review.
Pause to assess what you have accomplished, and review what what lies ahead.



Pre-defined Methodology lets you focus on the engineering problems.

Lessons Learned

Document Production. With a team, you have different format and submittal requirements. Give organizational credit.



Final Assessment and Interpretation of results. Half empty or half full ? The Intended Use is critical.

Do not apply standards for Operational Software to a Computer Simulation

The Art of V&V

The Art of War: Its Application to V&V of Models and Simulations

- **OBJECTIVE**: You and the customer must agree on the intended use
- **PLANNING**: Prepare clear, uncomplicated plans and procedures
- **OFFENSIVE**: Demand early, unofficial deliveries
- **MASS**: People and computers must be in place and ready
- **ECONOMY OF FORCE**: Do not get distracted by problems or issues unrelated to the Intended Use
- **MANEUVER**: Be flexible and adaptable to the technical and programmatic problems encountered late in the process

SUMMARY

- Procedures can be selected based on customer constraints and needs
- A pre-defined methodology means resources used for engineering instead of process design
- The JNTF methodology results in a high quality product even in a resource constrained environment